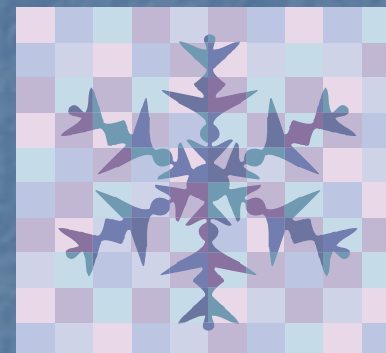


# Teleconnections, ENSO, and the mid-Atlantic Winter



Larry Brown, Meteorologist/Climate Focal Pt, NWS Wakefield, VA  
Winter Weather Workshop 5 December 2007

# OUTLINE

- **ENSO:**

- What is “ENSO”
- How does it affect the mid-Atlantic region
- Trends?

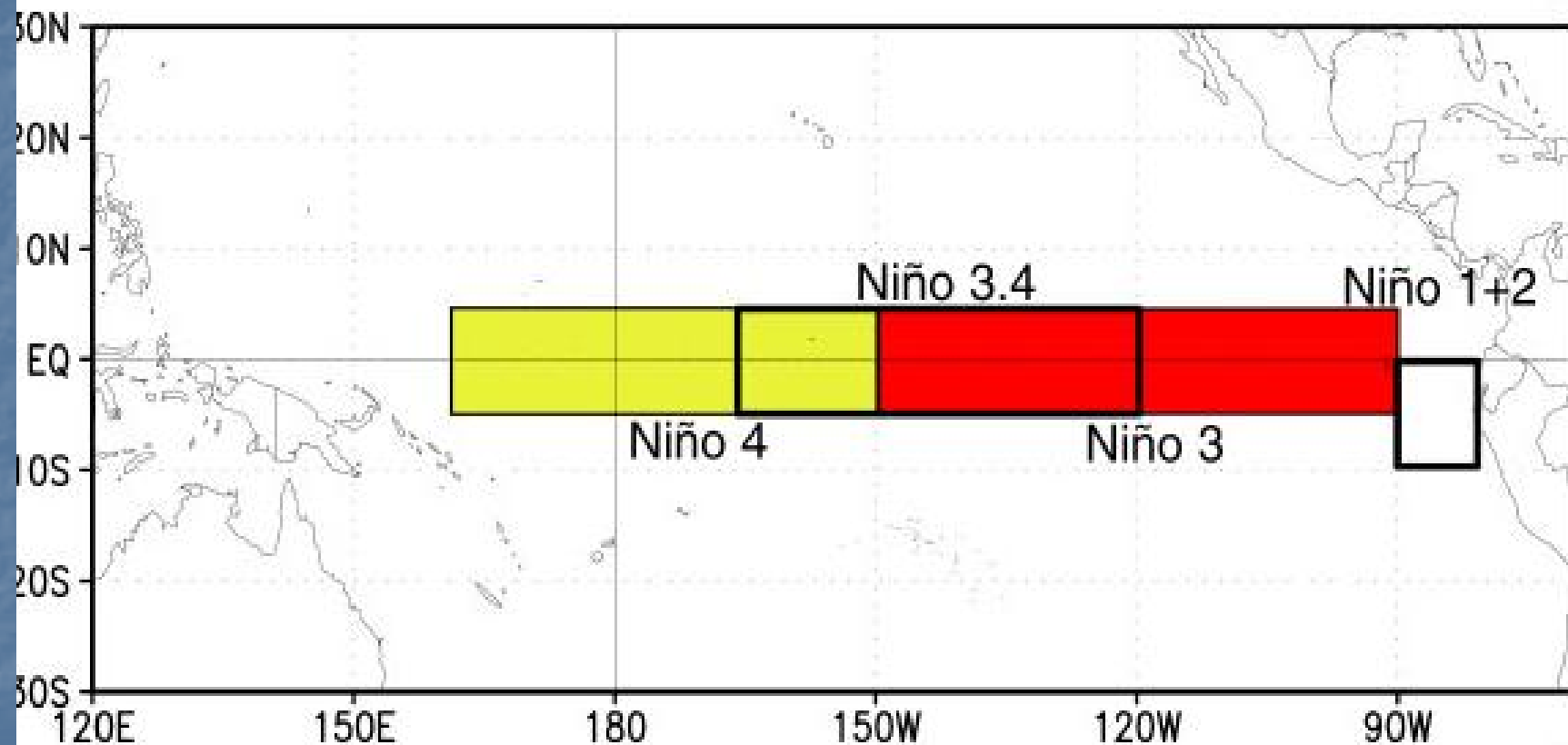
- **Teleconnections:**

- NAO & PNA
- How do they affect Temperature & Snowfall
- Trends?
- Are teleconnections linked to ENSO?

# What is ENSO (El Nino and La Nina)?

- **“El Nino Southern Oscillation”** In a nutshell, ENSO is the sea surface temperature over portions of the Pacific Ocean with respect to average for a given time of year.
- The most commonly used index (and the one that has been shown to show the best forecasting skill) is the “Nino 3.4” region which takes the sea surface temperature anomaly of the tropical Pacific Ocean averaged over the region between 5 degrees north and south latitude and 120 to 170 degrees west longitude.
- When the water temperatures are above average (by at least 0.5 C), an El Nino is occurring, and cooler than normal SST (by a magnitude of at least 0.5 C) indicates La Nina.

# *El Niño Regions*



Graphical depiction of the four Niño regions.

Source: CPC



## El Nino Categories (La Nina is negative/cold)

- **Weak El Nino:** Water temperature in the Nino 3.4 region is 0.5 C to 0.99 C above normal.
- **Moderate El Nino:** Water temperature in the Nino 3.4 region is 1.0 C to 1.49 C above normal.
- **Strong El Nino:** Water temperature in the Nino 3.4 region is 1.5 C (or greater) above normal.

# ENSO Model Forecast

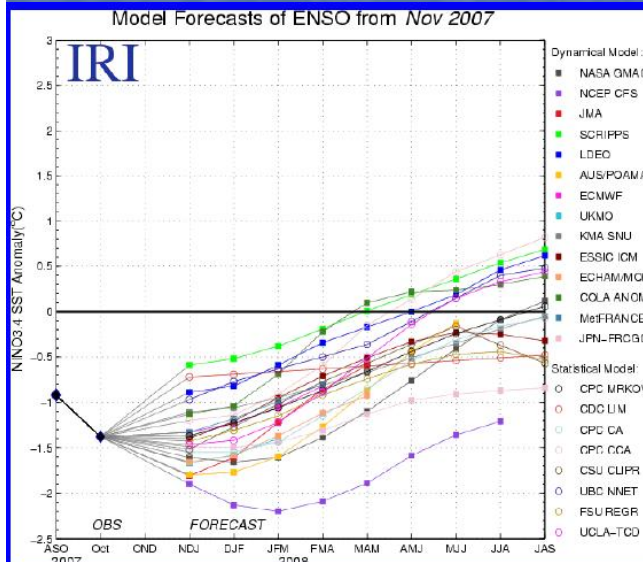
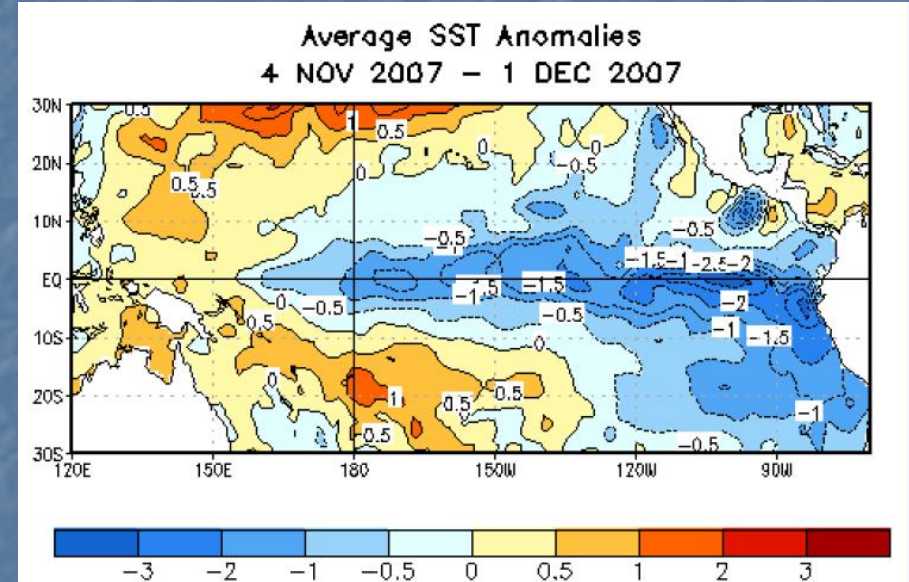


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 17 November 2007).

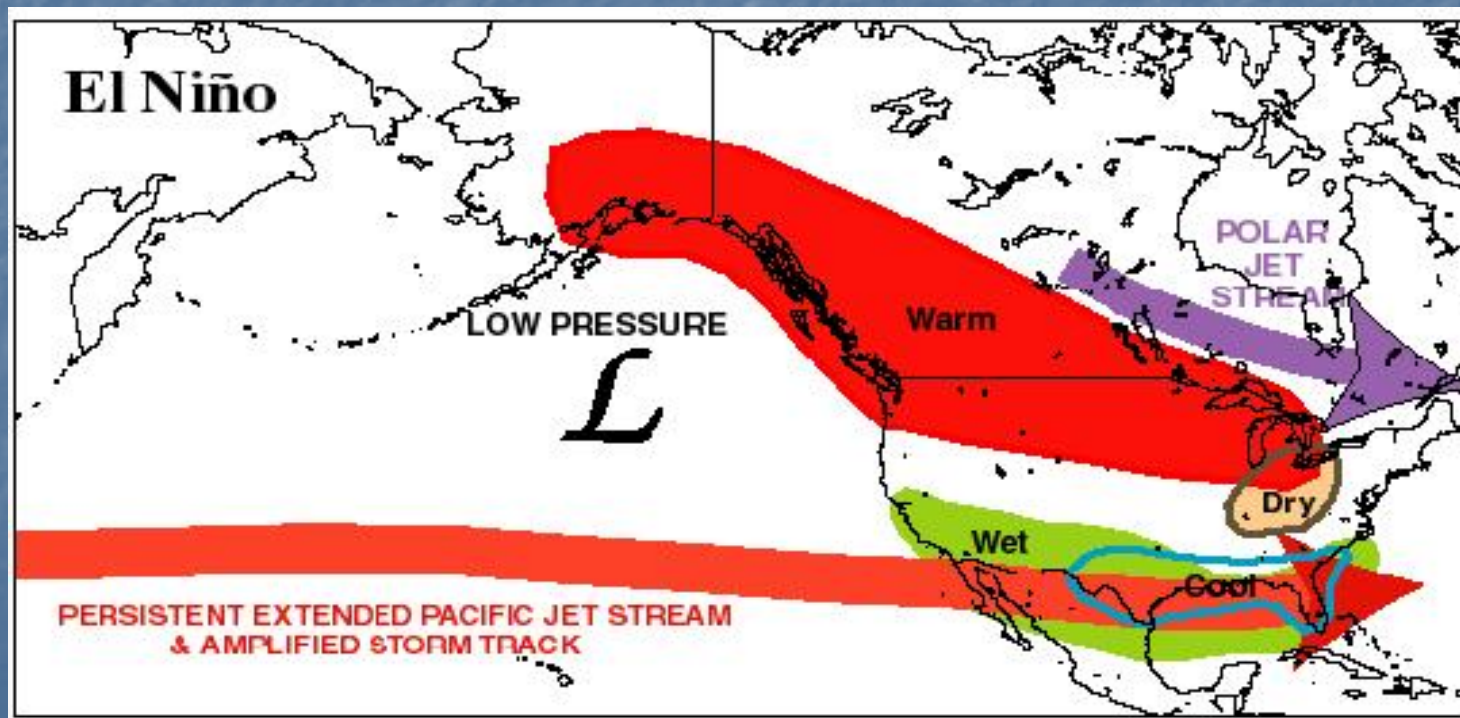


- Currently we are well into what will potentially become a moderate La Nina event (need 5 consecutive months), with a spread in the models, most forecasting conditions to be moderate (or strong) La Nina for the upcoming winter.



# Ok, so who cares...

- How does something in the Pacific affect us? “El Nino” shown below (La Nina is almost the opposite)



Source: CPC

# This Study...

- Ranked ENSO based on the Nino 3.4 Region (ONI) for all events since 1950
- Nov-Mar ONI was calculated for each season (1949/50, 1950/51, through 2006/07 season)
- This yields
  - 17 El Nino cases (ONI  $\geq +0.5$  C)
  - 24 Neutral cases (ONI between +0.5 C and -0.5 C)
  - 17 La Nina cases (ONI  $\leq -0.5$  C)
- Five sites within the Wakefield (AKQ) CWA were utilized, 3 are first order stations and two co-op stations.

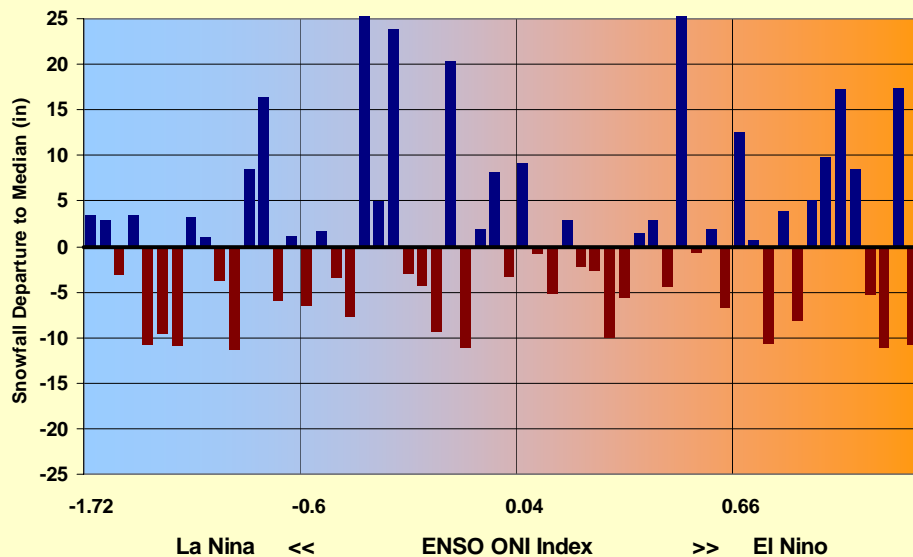


# Overall...

- TEMPERATURE (Dec-Mar)/1950-2007:
  - *Average Temperature:*
  - Slightly colder than average with El Nino episodes.
  - Slightly warmer than average with La Nina episodes
  - \*\*\*However, none of cases are statistically significant
- SNOWFALL (All Season)/1950-2007:
  - Slightly more snow than average with El Nino episodes
  - (except ORF)
  - Slightly less snow than average with La Nina episodes (except ORF)
  - \*\*\*None of the cases are statistically significant

# ENSO Affects (CONTINUED):

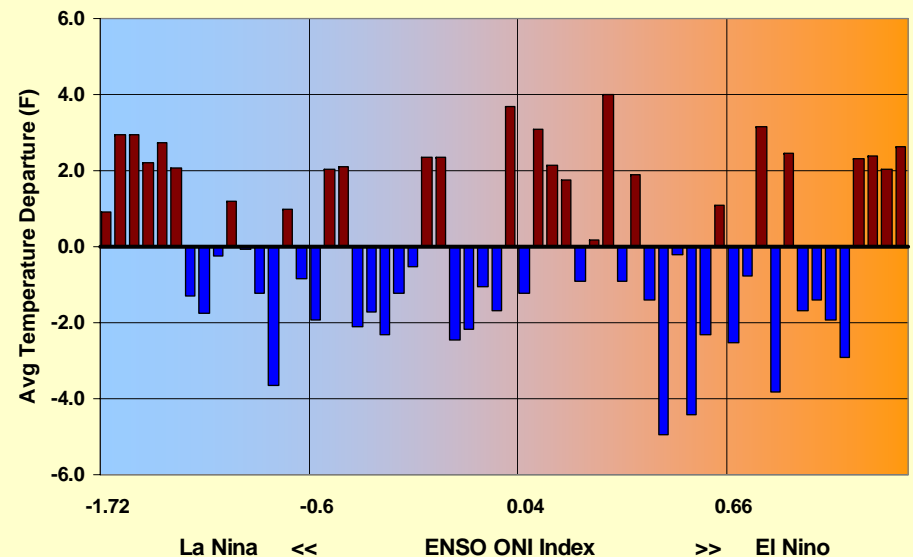
Richmond, VA (RIC) Snowfall Departure vs ENSO State



## Snowfall:

- Slight increase with El Niño
- Slight decrease with La Niña
- Highly Variable!!

Richmond Dec-Mar Avg Temp Departure vs ENSO State



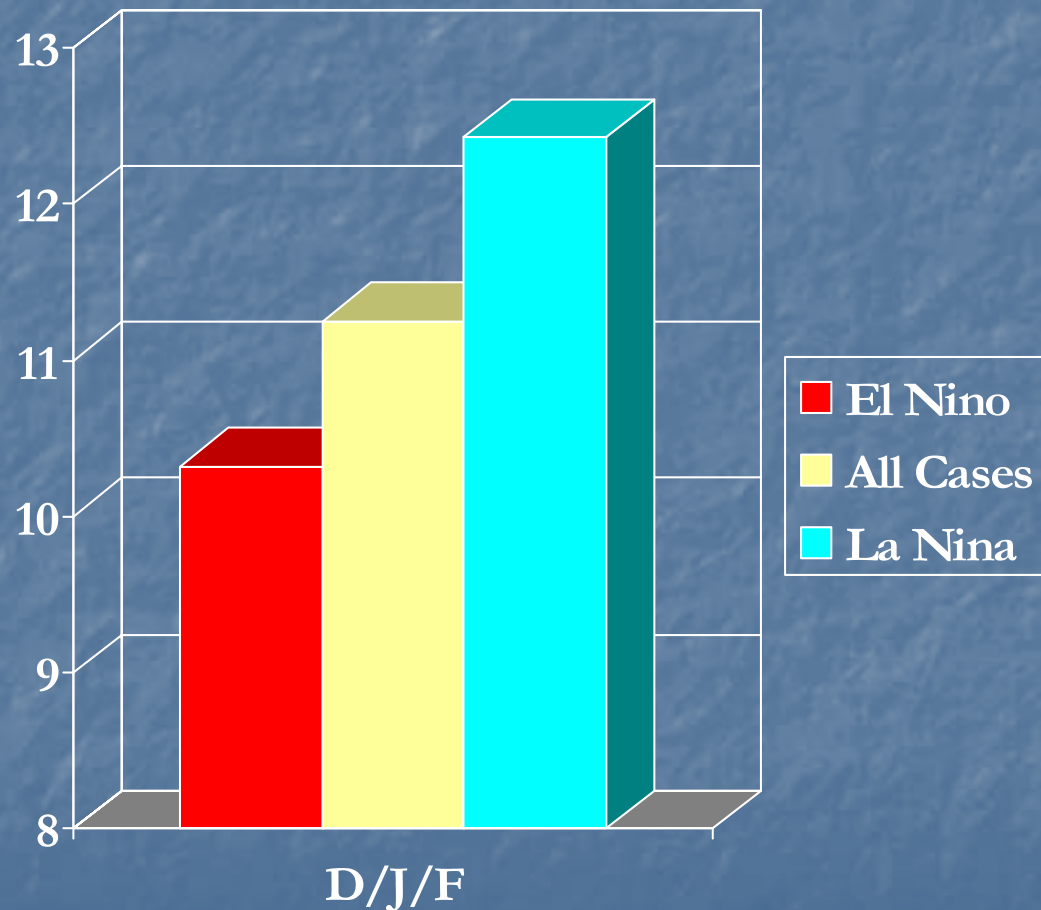
## Temperature:

- Slightly colder with El Niño
- Slightly warmer with La Niña
- Both Strong El Niño and Strong La Niña are warm.

# What about Variability?

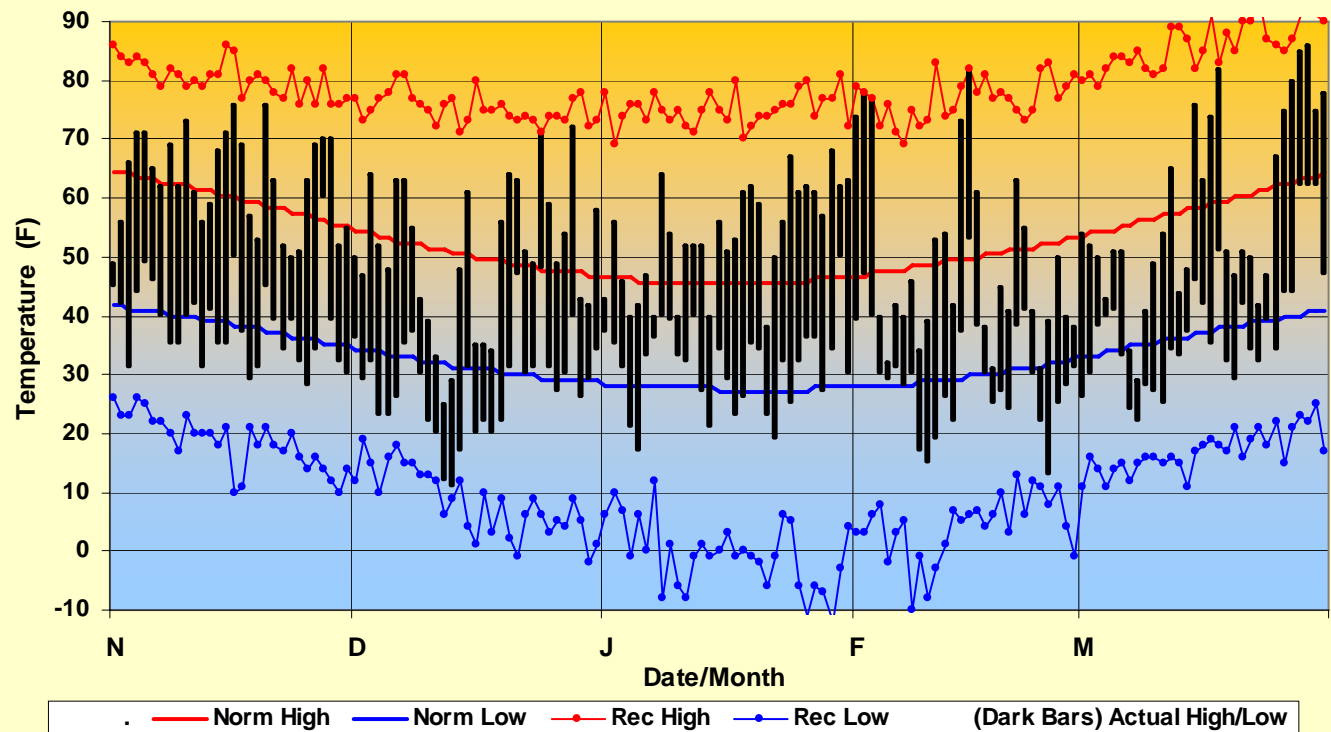
Richmond, VA Std Dev of High Temperature

- Note greater variability than average with Moderate to strong La Nina cases.
- Lower than average variability with mdt to strong El Nino cases.



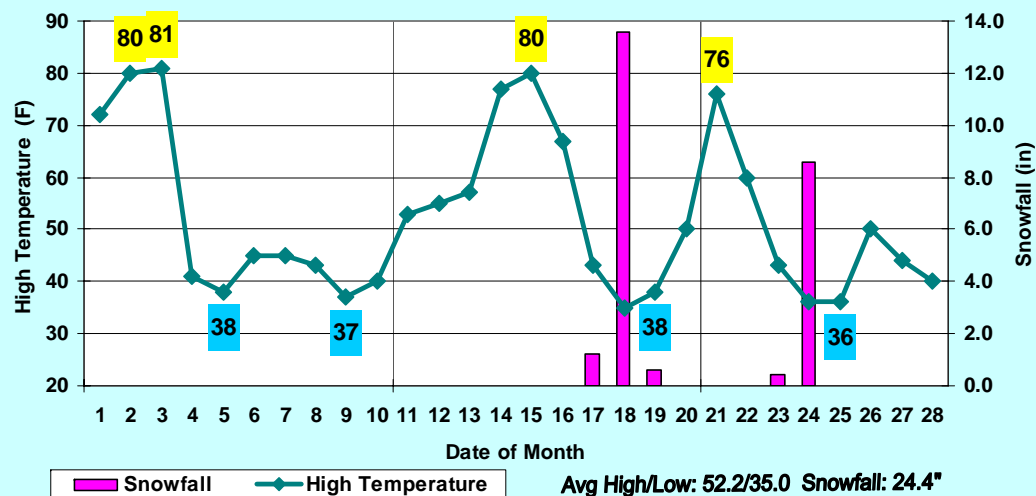


Richmond, VA Winter 1988-1989 Temperature (*Strong La Nina*)



# Strong La Nina Example: Winter 1988/89

Norfolk, VA February 1989 (Daily High Temp and Snowfall)



Wow!!

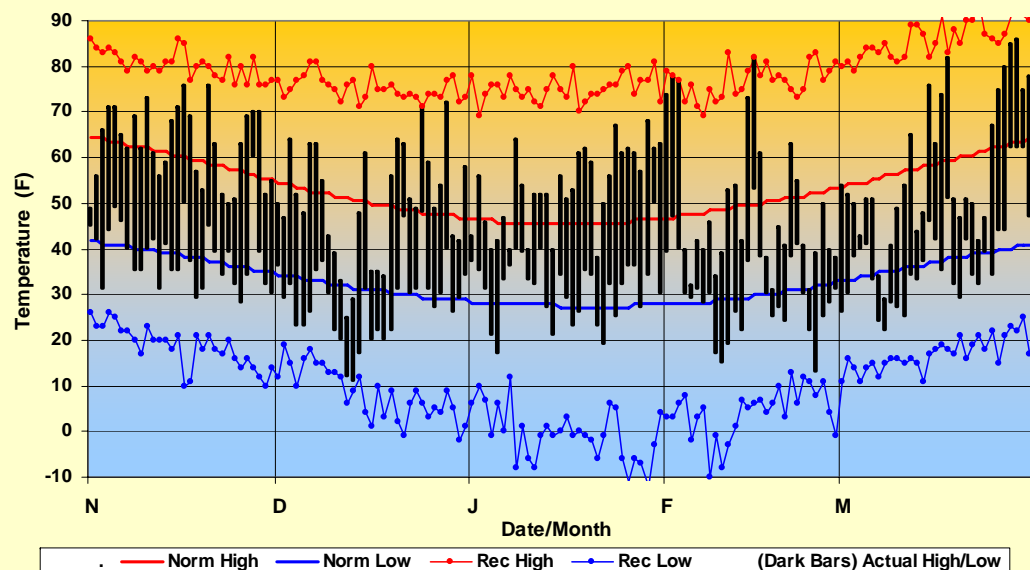
High temperature

std dev 17 F

"Near Normal" temperature for the month.

Snowiest Feb on record at Norfolk

Richmond, VA Winter 1988-1989 Temperature (Strong La Nina)



# Teleconnections

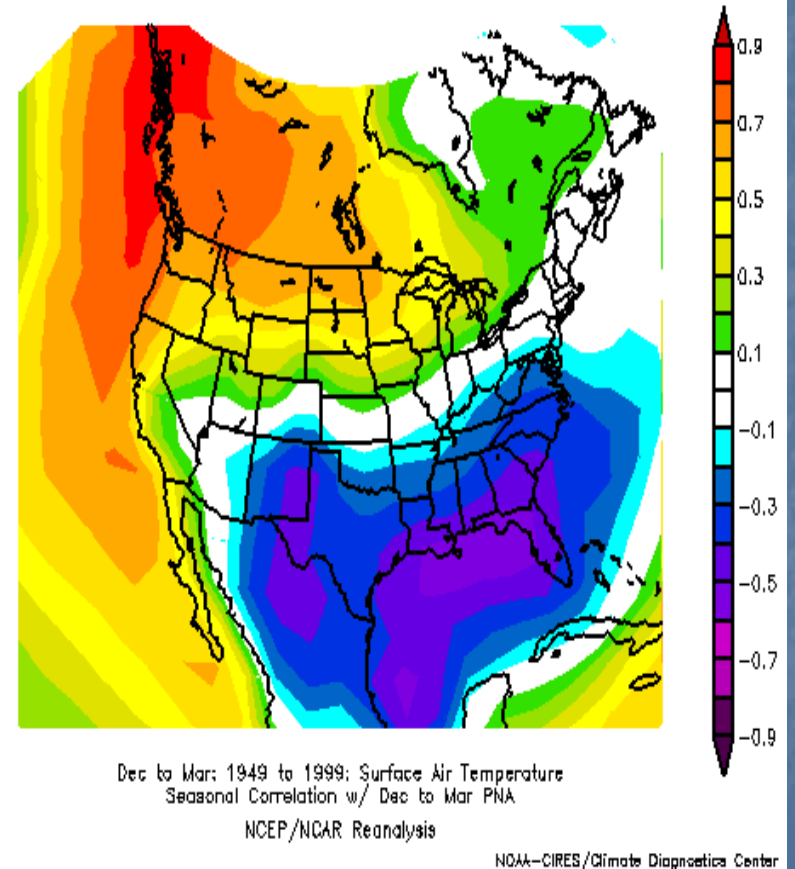
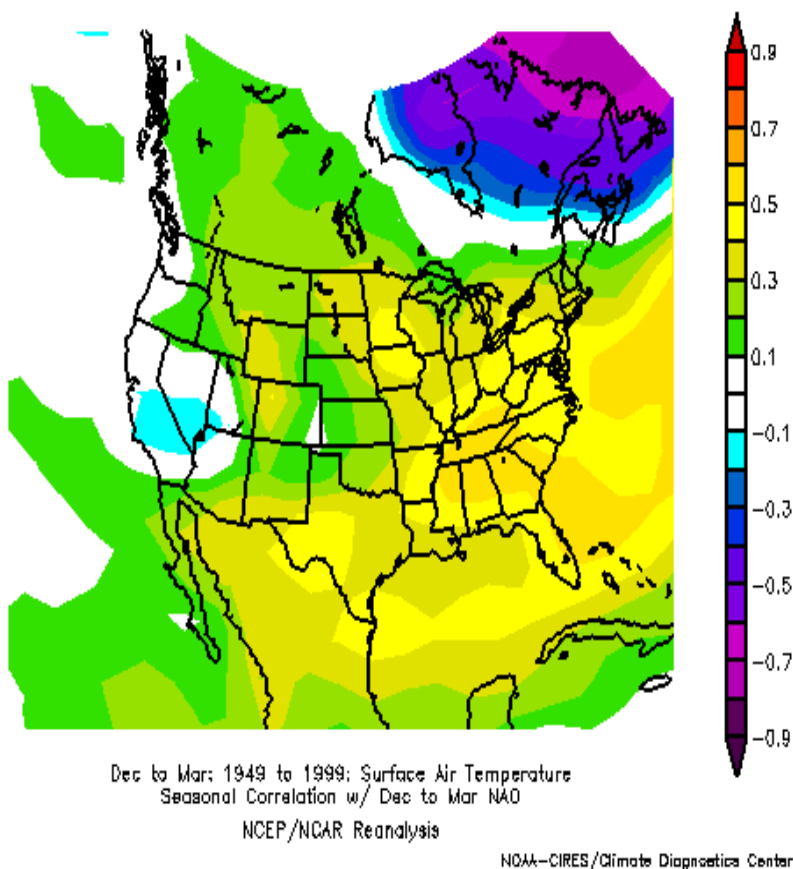
- PNA “Pacific North American” pattern
- NAO “North Atlantic Oscillation”



# Mean (Dec-Mar) Surface Air Temperature Correlation to:

## NAO

## PNA

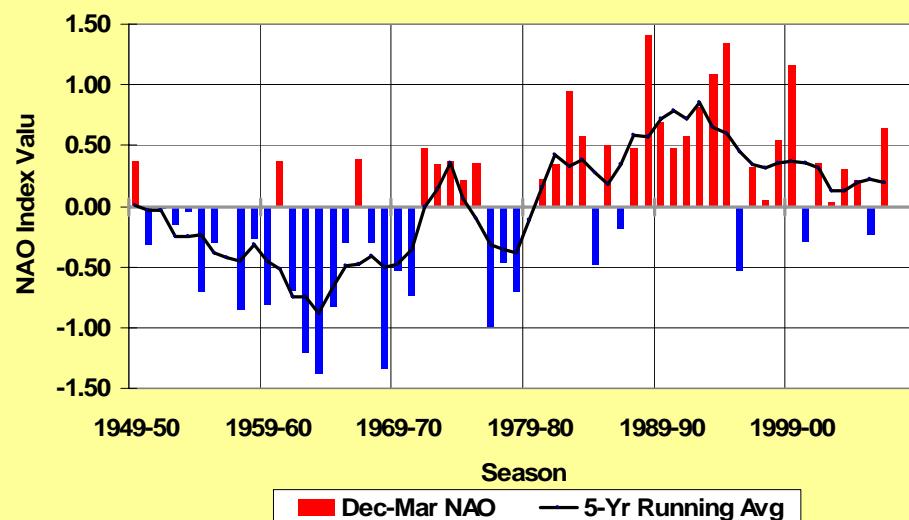


NAO: (+Phase= warm in eastern US)

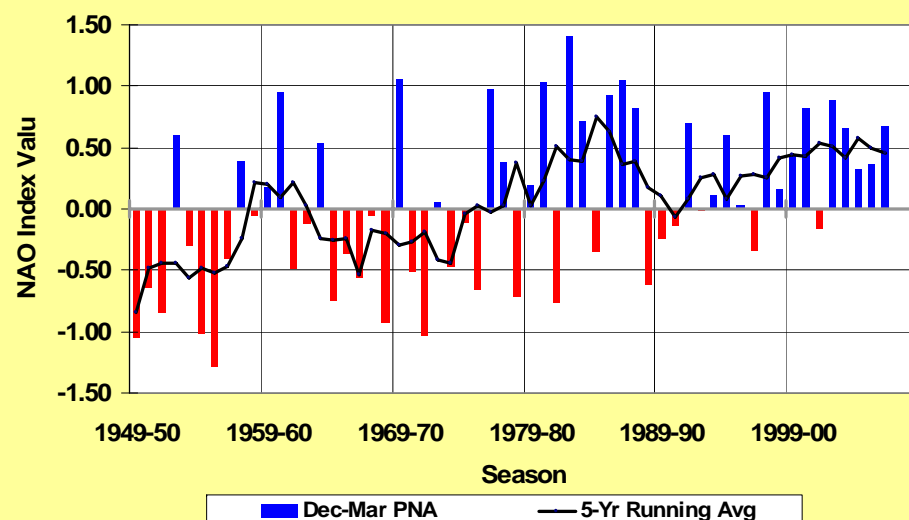
PNA: (+Phase= cold in SE US)

# The NAO & PNA since 1949/50:

NAO Dec-Mar Index (1949/50-Present)

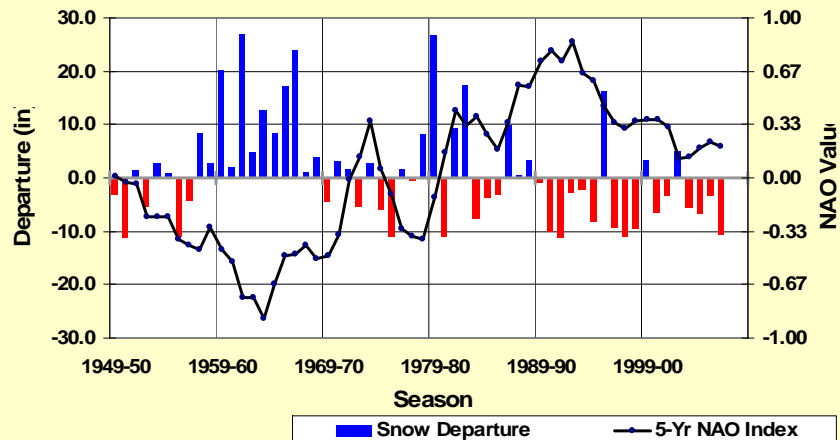


PNA Dec-Mar Index (1949/50-Present)

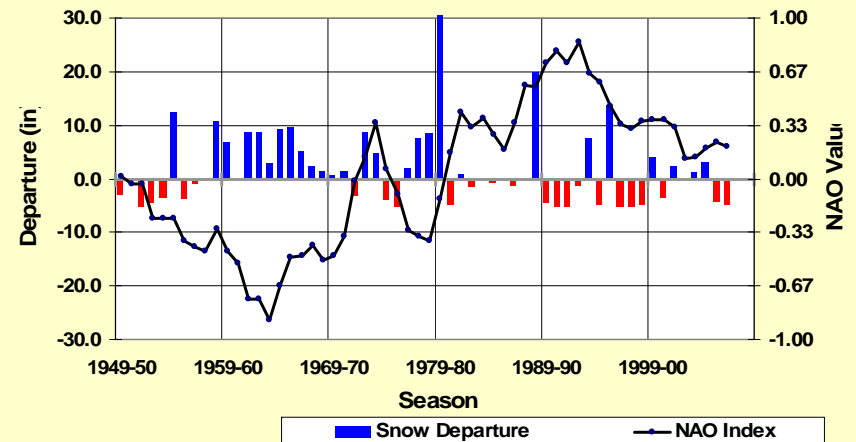


# Link to the NAO Phase?

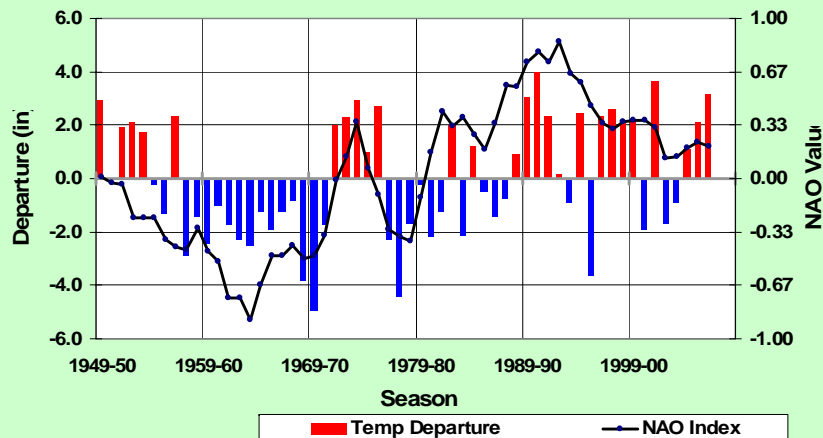
Richmond, VA (RIC) SNOW vs NAO



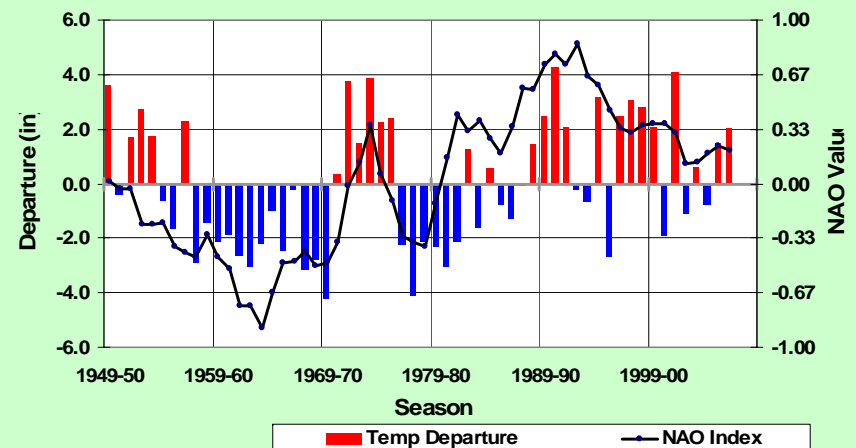
Norfolk, VA (ORF) SNOW vs NAO



Richmond, VA (RIC) Dec-Mar Avg Temperature vs NAO

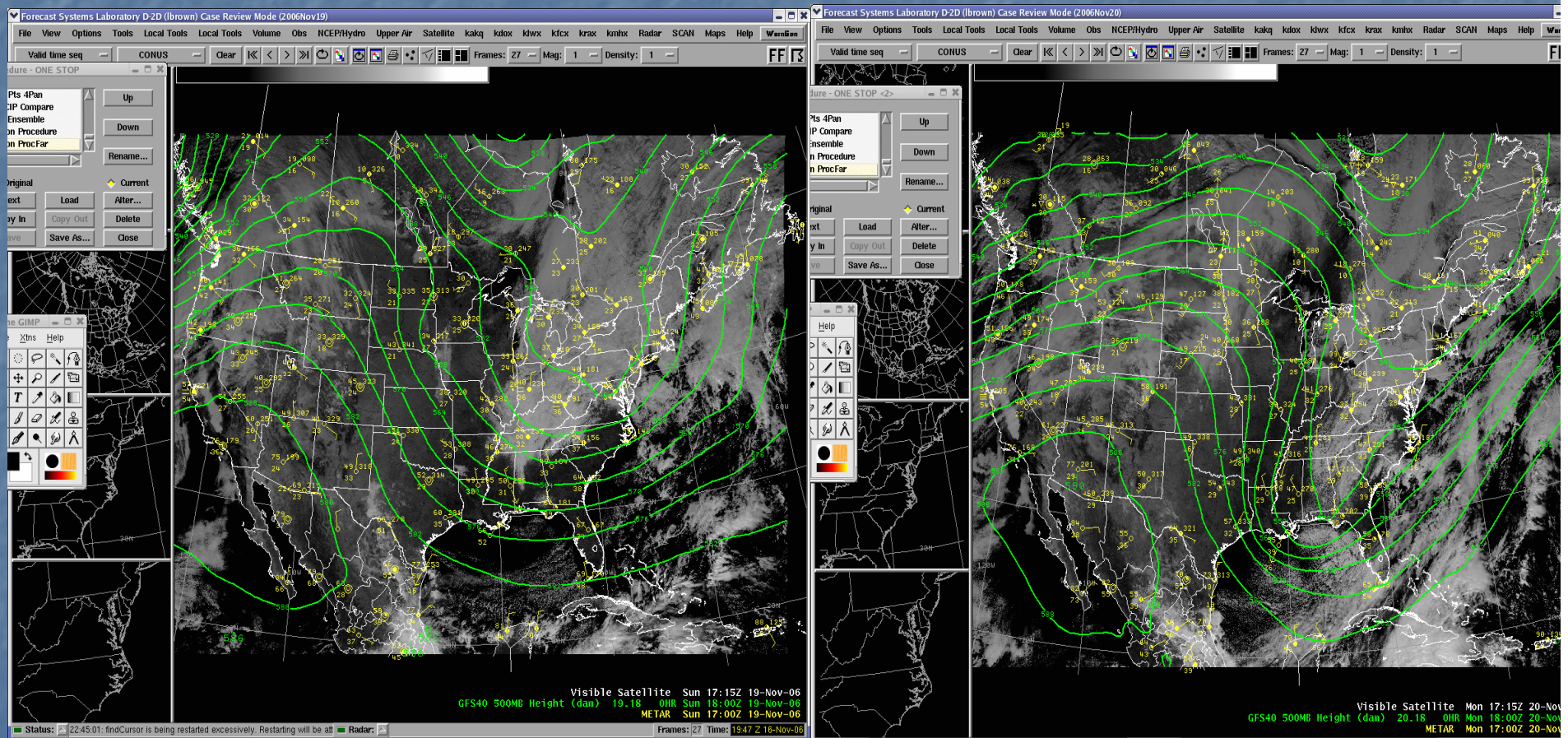


Norfolk, VA (ORF) Dec-Mar Avg Temperature vs NAO





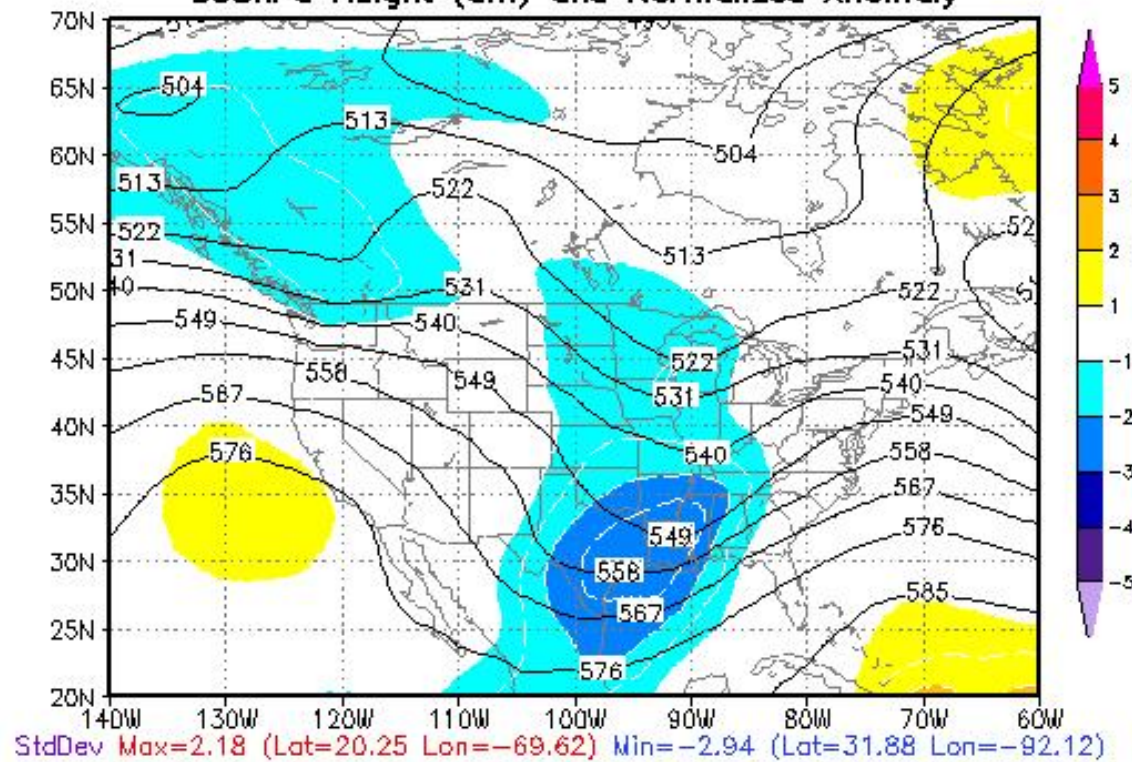
# A Good example of positive phase of the PNA: late Nov 2006



# PNA: what phase is this?

12Z07FEB1979

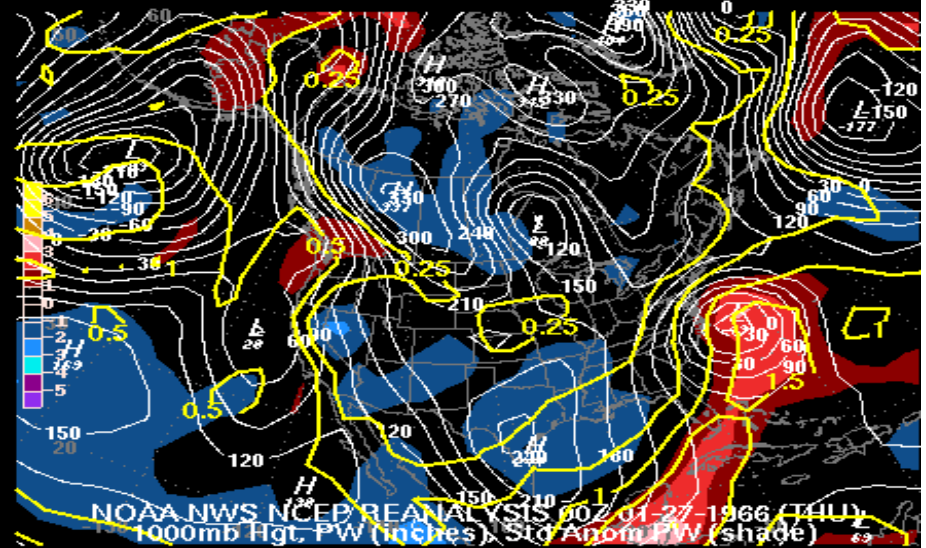
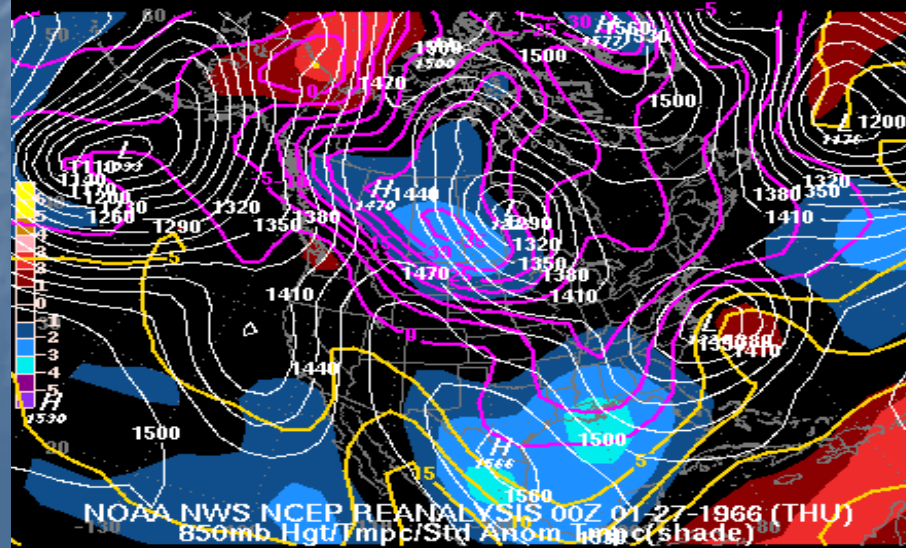
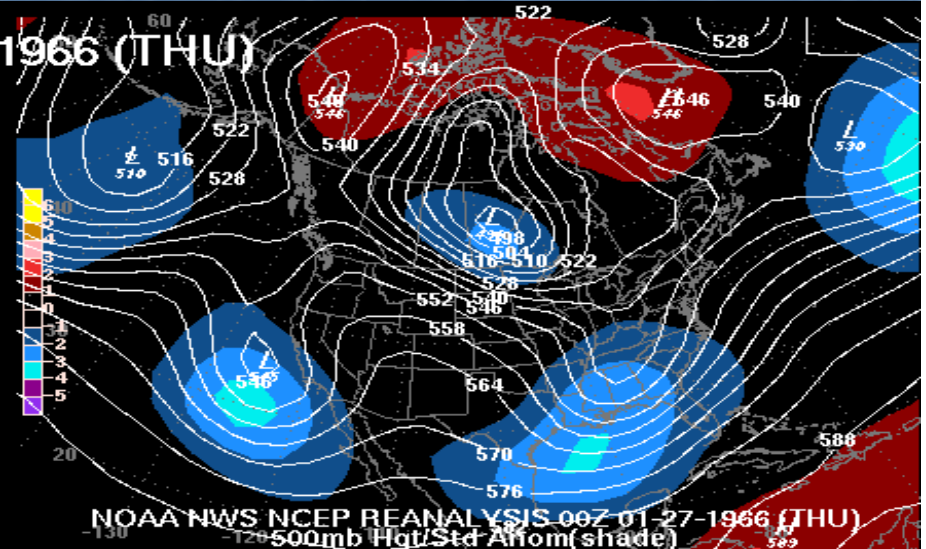
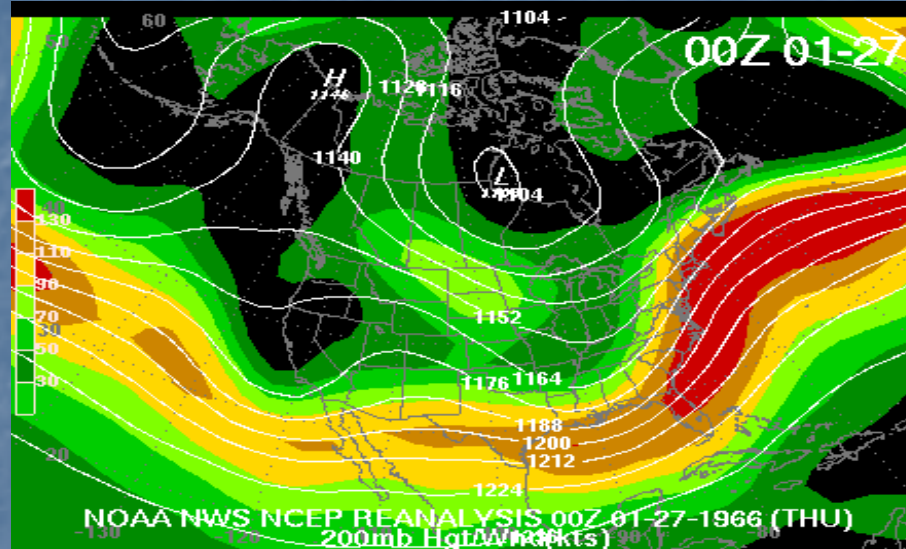
500hPa Height (dm) and Normalized Anomaly



- RIC received 6.4" snow
- Norfolk received 5.1"



An example of a storm that brought 9.4 inches of snow to Norfolk, and over a foot at Richmond. This occurred during the **negative phase** of the NAO.





Questions?